ON THE BIONOMICS OF *HIPPOBOSCA EQUINA*

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Distribution in Wales

Hippobosca equina is very localised in its habits, being more abundant on the Continent than in Great Britain; records of infestation of horses and cattle are found in most European countries, and also from Palestine, where it is extremely common on horses and dogs during spring and summer (Buxton, 1924). In Britain, the New Forest in Hampshire and certain of the sheltered valleys of South Carnarvonshire and North Merionethshire in North Wales, appear to be the only known areas where the fly is abundantly found.

H. equina occurs in but a few localised areas in North Wales, and chiefly in the secluded and protected valleys of the southern spur of the Snowdonian mountains. On making an investigation of most of these valleys and taking notes of the approximate numbers found, a striking disparity was remarked in the prevalence even in neighbouring valleys. The reason for this limited distribution has been one of the chief objects of the investigation. The fly is distributed as follows:—in the valley which runs from Portmadoc to Beddgelert it occurs, but not very commonly, and also in the smaller lateral valleys. Somewhat further to the West lies the deep winding valley of the river Dwyfawr, known as the Pennant Valley; here the fly is abundant. This valley is chiefly given over to sheep farming, but on the lower lands a number of cattle are kept, and owing to the habit of milking the cows out of doors in summer, the cattle were more readily approachable and the work of the observation thus rendered easier. Most of the field work, therefore, was carried

out at this valley, and chiefly about the little village of Llanfihangel-y-Pennant, which is conveniently situated near the main road leading from Tremadoc to Garn Dolbenmaen, and above which the valley runs for a distance of five miles into the hills. Another smaller valley running almost parallel to the Pennant, and known as Cwm Ystradlyn, has also supplied data. All these valleys lie in the main north-east to south-west direction. The upper reaches are steep ascents merging into mountain, while the lower portions are wooded. The valley bottoms are wide and level and well suited to the typical hill farming of cattle and sheep rearing. There is a mean annual rainfall of 45 to 50 inches.

The village of Beddgelert and district is commonly supposed to be the real habitat of *H. equina*, and the insect is locally known as the Beddgelert Fly, but it has not been found so abundantly there as in the Pennant valley. *H. equina* is also found on the northern slopes of the Snowdonian mountains, in the valley running up from Llanberis, about a small village known as Nant Ucha, an important route for stage coaches in the past, but now almost exclusively used for motor traffic. Many of the older inhabitants speak of the way horses used to be worried and terrified, but its occurrence there is now rare. The fly is also known to occur about Bala and Llanuwchllyn in North Merionethshire.

From an historical point of view it is rather disappointing not to be able to record what is felt would have been interesting reading, dealing with the molestation of coach horses of which frequent mention was heard ; but the information gleaned seems unreliable, and the passing of time has in no way helped to enhance its value. Suffice it to say that the replacing of horse by motor traffic has caused the fly to become of less economic importance and the old coach roads are particularly free from the pest, which is now concentrated about the cattle lands.

Factors Controlling Occurrence

A succession of wet summers and the distance of the valleys named from Bangor has added considerably to the task of observing the natural habits of *H. equina*. The nights are invariably cold, with heavy dews. When the sun shines the flies are to be abundantly obtained from both horses and cattle, but during cold or rainy days

very few are to be noticed. The entrance to the Pennant Valley is well wooded and cattle grazing in these parts are not so much infested as those higher up the valley, where there are fewer trees. The trees are mostly Ash and Oak, giving way to a dense covering of Bracken (*Pteris aquilina*) which dominates the western side up to where the valley ends ; this side is also steeper than the eastern, which has a more gradual rise and better pasture. Animals grazing on the western side were found to harbour a greater number of flies than those of the opposite side.

This relative prevalence of *H. equina* in one localised area was most fortunate, greatly facilitating the work of comparison and analysis of factors which were supposed to be conducive and favourable to its existence. The geological formation of the area covered is chiefly Cambrian, with its associated shales and slates, this same rock formation being dominant throughout the range. The presence of trees seems in no way necessary to the activities of the flies, and the number obtained was smaller when cattle were sheltering in their cool shade ; there was, also, not much difference in the facies of either side of the valley in their lower and wooded regions. Climatic conditions claimed greater attention, it being well known that *H. equina* is more active during sunshine than at other periods. The western side receives the sun's rays earlier, and thus has a greater period of warmth daily than the opposite slopes which remain cold up to mid-day—this factor may well be of importance. But the most striking difference lies in the abundance of bracken on the western and its comparative scarcity on the eastern slopes. Several farmers had previously suggested an association between *H. equina* and bracken, and acting upon this information a close observation of the habits of the fly has revealed an association which is the main factor for localisation, namely a dependence upon the presence of bracken. During the day *H. equina* are only occasionally found settling on the fronds sunning themselves, but at sunset, or when a spell of cold weather or rain is imminent, they generally leave the cattle and settle on the undersides of the fronds, such a position offering shelter and protection during the night. The main association, however, appears to be during the period of pupation, which will be discussed later.

Hosts

The chief hosts of *H. equina* are horses and cattle, though in their absence the flies are stated to attack other domestic animals, or even man (Neveu-Lemaire, 1912). They usually occupy a position safe from disturbance by the host, generally clustering together under the tail of cows, along the perinaeum, and occurring even as low as between the thighs and on the udder. The skin at these places is thinner than at other parts and without a dense hairy covering, but, the inaccessibility of the parts chosen demonstrate the necessity for freedom from molestation during long spells of feeding. When disturbed, *H. equina* scatter in all directions and exhibit their marked capacity of varied and rapid movements. Many try to conceal themselves in the positions indicated, and only resort to flight as a final alternative. Animals which have been reared in these valleys are so accustomed to the presence of the fly that little or no resentment is shown at their presence. In the country investigated *H. equina* has only been observed on cattle and horses ; but a very interesting report has been received from one of the chief sheep owners who states that he has observed the pest on dogs. Young sheep dogs (not having completed their training) are stated to have been attacked in each of three cases noted ; the older dogs are described as running through the bracken with their heads held high, whilst these young dogs, through keeping their heads too near the ground were attacked. The infested dogs, holding their heads to one side, make efforts to rid themselves of the pest with their paws, the insects being eventually found on the inner surface of the pinna of the ear. This evidence is borne out by the statements of both Neveu-Lemaire and Buxton (*op. cit.*) in their records of the observation of *H. equina* on dogs. A closely related species *H. capensis*, v. Olf. (*H. canina*, Rond), is always found in large numbers on the head and neck of pariah dogs in the near East (see Buxton, *op. cit.*). Unfortunately the writer is unable to confirm these statements from personal observation.

In most of the districts, cattle are sent out to pasture in early summer, and are not brought indoors again until the cold weather sets in. The majority of the cattle kept in the hilly districts are Welsh Blacks or crosses of that breed, and tables of occurrence of the

pest were kept to ascertain whether the lighter coloured animals were more liable to infestation. Little difference was found in the aggregate, and the following data from a typical farm show the colour of cattle, and the number of *H. equina* found. This indicated that both light and dark coloured cattle are similarly infested. These figures were obtained on August 2nd, six cattle yielding the following : Black, 17 flies ; Black, 9 ; Black, 4 ; Blue Grey, 15 ; Roan, 10 ; Blue Grey, 4 ; giving a rather low average of 9·8.

Mode of Dispersal

Residents of the infested areas state that *H. equina* does not migrate of its own accord, but is distributed by host animals, and all evidence points to this view being correct. The mountain ranges are almost impassable barriers to insects that seldom fly more than a few yards, and unless strong winds carry them (which is very improbable) they are entirely dependent for their distribution on the movement of cattle and horses. When cattle are driven or taken away from their pasture, some of the flies present upon them may adhere and accompany them for considerable distances. This is well known to the local farmers. One of the chief reasons for the failure of the fly to extend its range, appears to be the fact that such flies are practically invariably caught and destroyed. The presence of one fly is sufficient to terrify animals not inured to it, the cattle racing wildly to be rid of it. Stallions from the infested areas, travelling the countryside, have been known to introduce the fly to new districts, but owing to the scrupulous care taken in destroying the pest, and the unsuitability of new environment, they soon die off. The following instance was brought to the notice of the writer. A farm outside the infested area was visited by a stallion from the Pennant Valley, carrying with it some of the flies. This led to trouble, mares becoming excited and restless, until every fly had been destroyed. Another instance of the annoyance caused by their presence was given by a blacksmith who had been shoeing a horse from an infested area, and which had left this some time previously. When a horse from a non-infested area was brought in, a fly that had left its host and was present in the smithy, rendered the shoeing impossible until the insect was detected and destroyed.

Collecting, etc.

H. equina is easily caught by hand, there being little risk of damaging the flies by this method owing to the tough and leathery consistence of the integument ; another method is to place a wide-mouthed bottle over a cluster. A forceps net eventually proved most successful for collecting them in numbers. Great difficulty was experienced in attempting to keep the fly in the live state for laboratory experiments, the failure of which necessitated relying entirely upon field observation. When the flies were transferred direct to breeding cages, they died within 48 hours, a few only surviving that period. All the gravid females (distinguished by their swollen abdomens) were placed in separate breeding cages, but clustering together deposited their larvae prematurely. When a single gravid female is placed in a tube there is the same premature deposition, within less than an hour in many cases. A final trial was made by arranging a layer of peat covered with young bracken, and transferring gravid females direct from the host into the cage containing it. The deposition in this instance was delayed and the larvae obtained turned black in colour but no imagines were bred out. Massonnat and Vinet (1913) also complain of the great difficulty that attended their efforts to produce adults.

These unsuccessful attempts at rearing left but one course open for the observation of the deposition of larvae and their development—a prolonged investigation in the field during periods of suitable weather. Well advanced gravid females were caught and a little cotton wool fixed to the underside of the abdomen with a drop of gum. This enabled a close watch to be kept on the activities of those marked, and to follow their movements when they left the cattle. Here may be noted the great advantage obtained in having one or more cows which will not heed the presence of the observer. After marking a few females in the morning it was found necessary to remain with the cattle for the greater part of the day.

Habits

For the greater part of the day *H. equina* rarely leave the host animal, but during cold or wet weather they are often found on the undersides of the bracken fronds. Occasionally they have been noticed sunning themselves either on the bracken fronds or on the

slabs which abound in the valley, but their activities are chiefly confined to blood sucking. Ormerod (1900) states that *H. equina* feeds on 'the perspiration given off by cattle during the period of their activity in the summer months' besides blood sucking. The nature of the mouth parts, with their narrow piercing stylet curving downwards and forwards and terminated by a distinct cutting apparatus, would seem to leave no doubts as to the nature of the chief food supply. The length of the proboscis is of some importance, that of *H. equina* being about the longest met with during an examination of the mouth parts of other Hippoboscidae; this is, no doubt, a necessity for the successful penetration of the hides of horses and cattle. It is still a matter of opinion whether the flexibility of the proboscis and its sweeping of surfaces allow the admissibility of Miss Ormerod's assumption, and moreover it is a very difficult matter to prove. In the writer's opinion the act of sweeping the surface is thought to be for the locating of a suitable spot for puncturing; and the length is an essential adaptation for reaching the blood-vessels.

Flight

The wings of *H. equina* are well developed, and it is a strong flier, but rarely makes flights of longer duration than is necessary to reach the bracken.

Numbers

The number of flies seen on any one animal varies considerably; as many as thirty may be obtained in some cases, though generally they range from ten to twenty. They are to be found in their greatest numbers on the part immediately below the genitalia and are only occasionally met with in the inguinal region, on the udder and the perinaeum.

The first appearance of *H. equina* is variable, being dependent to a great extent on weather conditions; they have been known to appear as early as April, but their usual time is May. The height of infestation is towards the middle of August and early September, when new individuals are appearing; there is then a sharp falling-off in numbers during the latter end of September, although a few persist into October.

Proportion of Sexes and Copulation

There is no great disparity in the proportion of sexes, the females being in a very slight majority. Copulation has always been observed to take place on the host animals; the male, without any preliminaries, grasps the female and remains in this position for but a short time.

Breeding Habits

The gravid females are readily distinguishable by their distended abdomen. When the larva is mature the females leave the host, but it is a matter of great difficulty to observe the act of deposition, which takes place among the organic débris that collects at the base of the stems of bracken (*Pteris aquilina*). After leaving the host the females settle on a frond of bracken and, dropping to earth, choose a situation in the decaying humus where the larva is deposited. The writer has observed this on five separate occasions all during early August. The larva is partially buried in the humus as soon as extruded. It is of a globular shape and creamy white in colour at extrusion, with a black cap and two conical projections at that pole. It is incapable of any individual movement and has little or no trace of segmentation. It pupates after the passing of a few hours, the larval integument simply becoming chitinised to form the pupal casing, whilst a gradual darkening of the integument takes place until the puparium is black. It is not essential for the larva to be placed in suitable surroundings for pupation as this will take place, in many instances, in a glass tube or other receptacle. In addition to the five cases of actual larval deposition in decaying humus noted above, the writer discovered twelve pupae among organic débris beneath the bracken. Further, two pupae have been discovered on pasture land (not far from bracken) lying in crevices of twisted roots of grass. It is believed that this is an unusual occurrence. The nature of the decaying humus beneath the bracken lends support to the assumption that this is the normal habitat of the pupae, as nearly all observed have been found here, and the actual deposition of larvae has been observed to occur here. In this position there is shelter from heavy rains, while moisture drips down from the fronds. The sun does not penetrate strongly.

and a continuous moisture is assured. The decay of the humus possibly supplies a certain amount of warmth during decomposition.

Climatic conditions may play an important part in determining the duration of the pupal instar, for during periods of hot weather newly hatched individuals were noted on the cattle. This is possibly due to a shortening in the duration of the instar owing to the warmth. The numbers are always greatest on cattle during such times.

In no case has the writer succeeded in hatching out any imagines under artificial conditions, despite a number of attempts, using breeding cages and varying temperatures and conditions.

SUMMARY

1. *Hippobosca equina* has a limited distribution in North Wales, and is restricted to certain valleys in South Carnarvonshire and Merionethshire. Its distribution seems to be governed by two factors :—(1) Presence of bracken, on which depends successful pupation, (2) The amount of sunshine available.

2. The chief hosts of *H. equina* are horses and cattle, although evidence is available to show that it attacks dogs.

3. Extension of range seems to be kept in check by a policy of destruction when stock are removed from its haunts or when an individual is noted in a new district.

4. As an economic pest it is a source of annoyance in terrifying animals not accustomed to its presence, and may then give rise to grave consequences. This factor appears of less importance since the diminution of horse transport. It now occurs almost entirely on cattle and confines its activities to blood sucking.

5. It was found impossible to keep the fly alive and conduct breeding experiments under laboratory conditions.

6. The fly is generally found from May to August.

7. Copulation takes place on the host animals.

8. From observation it seems probable that the decaying humus beneath growing bracken is the normal habitat for deposition of larvae.

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